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| 10/750,919 | 12/31/2003 | Carl A. Waldspurger | A38 | 1896 |
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| VMWARE, INC. DARRYL SMITH 3401 Hillview Ave. PALO ALTO, CA 94304 | | | EXAMINER YU, JAE UN | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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|------------------------------|--------------------------------------|---|--|
| Office Action Summary | Application No. 10/750,919 | Applicant(s) WALDSPURGER ET AL. | |
| | Examiner Jae U. Yu | Art Unit 2185 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 May 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

The examiner acknowledges the applicant's submission of the amendment dated 5/22/07. At this point claims 1-28 are pending in the instant application.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. Claims 19, 21 and 23-28 are rejected under 35 U.S.C. 102(e) as being anticipated by Nelson et al. (US 6,857,057).
2. Independent claim 19 and dependent claim 24 disclose; "maintaining, in an unmodified state, the contents of the virtual disk [**maintaining the snapshot of the virtual disk, Figure 3**] at the time for which the checkpoint is generated, while allowing the VM to continue using the virtual disk [**"Write" operations, Figure 3**]",

"saving substantially all of the device state of the VM, at the time for which the checkpoint is generated, to a checkpoint data store [**saving state of the primary VM to secondary VM via snapshot operation, Figure 3**]",

“marking the set of VM memory [**“Memory” (Figure 1) providing a temporary storage area for the disks, Column 4, Line 20-21**] as copy-on-write (COW) [**snapshot operation, Figure 3**], the set of VM memory constituting original VM memory”,

“allowing the VM to continue using the VM memory [**“Write” operations, Figure 3**]”,

“responding to memory COW faults related to the VM memory by generating copies of the original VM memory [**snapshot operation, Figure 3**] for read and write use by the VM [**recovering the parent disk file by using the snapshot disk file, Column 1, Lines 37-39**]” and

“saving the original VM memory to the checkpoint data store [**transferring the data saved in the temporary memory to “storage space” 14, Figure 1**]”.

3. **Claims 21 and 27** disclose, “the virtual disk is initially mapped to a parent disk file on a physical disk [**“Storage Space” (RAID), Figure 1**] and wherein the step of maintaining, in an unmodified state, the contents of the virtual disk comprises creating a copy-on-write (COW) disk file pointing to the parent disk [**creating a snapshot disk (RAID, Column 3, Line 7) file, Element 42, Figure 3**] and mapping the virtual disk to the COW disk file”.

4. **Independent claim 23** discloses; “maintaining, in an unmodified state, the contents of the virtual disk **[maintaining the snapshot of the virtual disk, Figure 3]** at the time for which the checkpoint is generated, while allowing the VM to continue using the virtual disk **[“Write” operations, Figure 3]**, the unmodified contents of the virtual disk constituting a checkpointed virtual disk **[the “snapshot” copy 47, Figure 3]**, and the contents of the virtual disk used by the VM constituting an ongoing virtual disk **[Element 40, Figure 3]**”,

“saving substantially all of the device state of the VM, at the time for which the checkpoint is generated, to a checkpoint data store **[saving state of the primary VM to secondary VM via snapshot operation, Figure 3]**”,

“saving the contents of the VM memory, at the time for which the checkpoint is generated, to the checkpoint data store **[transferring the data saved in the temporary memory to “storage space” 14, Figure 1]**, and allowing the VM to continue using the VM memory **[“Write” operations, Figure 3]**, the contents of the VM memory saved to the checkpoint data store constituting a checkpointed VM memory **[memory (18, figure 1) for the “snapshot” copy 47, Figure 3]**, and the contents of the VM memory as used by the VM constituting an ongoing VM memory **[memory (18, Figure 1) in Element 40, Figure 3]**” and

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“allowing the VM to execute **[transferring the data saved in the temporary memory to “storage space” 14, Figure 1]** during at least a part of the time during which the checkpoint is being generated, and ensuring that the results of any pending disk writes are applied to both the checkpointed virtual disk and the ongoing virtual disk

[transferring the data saved in the temporary memory to “storage space” 14, Figure 1], that the results of any new disk writes are applied to the ongoing virtual disk **[“First Write” 49, Figure 3]**, but not to the checkpointed virtual disk, that the result of any pending disk reads are applied to both the checkpointed VM memory and the ongoing VM memory **[reading the data saved in the cache, Column 4, Lines 20-23]**, and that the results of any new disk reads are applied to the ongoing VM memory **[reading the data stored by the “First Write” (49, Figure 3)]**, but not to the checkpointed VM memory”.

5. **Claim 25** discloses, “reissuing any pending disk reads for which the results of the read were directed to original VM memory **[reading the data saved in the cache, Column 4, Lines 20-23]** for which a COW fault has occurred, but directing the reissued disk reads to the corresponding copies of the original VM memory **[reading the data saved in the cache (restored by the “snapshot” storage device), Column 4, Lines 20-23]** instead of the original VM memory”.

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6. **Claim 26** discloses, "forcing COW faults for any original VM memory [reading the data saved in the cache (restored by the "snapshot" storage device), Column 4, Lines 20-23] that would otherwise be affected by the new disk reads".

7. **Claim 28** discloses, "if there is a pending disk write to the same COW block group as a subsequent write for which a disk COW fault has occurred, delaying responding to the disk COW fault and delaying the subsequent write until the pending disk write completes [transferring the data saved in the temporary memory (RAM, Column 4, Lines 18-25) to "storage space" 14, Figure 1] & [restoring the primary storage by using the snapshot storage]".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1. **Claims 1-13, 15-18, 20 and 22** are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelson et al. (US 6,857,057) in view of Yasuda et al. (US 2004/0010654).

2. As per **independent claim 1 and dependent claims 20 and 22**, Nelson et al. disclose; "creating a copy-on-write (COW) disk file [creating a snapshot disk (RAID,

Column 3, Line 7) file, Element 42, Figure 3] pointing to the parent disk file [Element 40, Figure 3] in use by the VM [Figure 2]",

"marking the memory ["Memory" (Figure 1) providing a temporary storage area for the disks, Column 4, Line 20-21] of the VM copy-on-write [snapshot operation, Figure 3], the VM memory constituting original VM memory",

"saving substantially all of the device state of the VM to memory [saving state of the primary VM to secondary VM via snapshot operation, Figure 3]",

"switching the VM to use the COW disk file instead of the parent disk file [recovering the parent disk file by using the snapshot disk file, Column 1, Lines 37-39]",

"handling disk COW faults to the COW disk file [handling disk error by RAID operation, Column 3, Line 7]",

"handling memory COW faults to the original VM memory [handling disk error by RAID operation, Column 3, Line 7] to generate copies of the original VM memory [snapshot operation, Figure 3] for read and write use by the VM",

"saving the device state from memory to a checkpoint data store [transferring the state saved in the temporary memory to "storage space" 14, Figure 1]" and

“saving the original VM memory to the checkpoint data store **[transferring the data saved in the temporary memory to “storage space” 14, Figure 1]**”.

Nelson et al. do not disclose expressly, “stopping the VM” and “resuming operation of the VM”.

Yasuda et al. disclose temporarily stopping operation in a virtual network in paragraph 84.

Nelson et al. and Yasuda et al. are analogous art because they are from the same filed of endeavor of virtual storage systems.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to modify Nelson et al. by temporarily stopping operation in a virtual network as taught by Yasuda et al. in paragraph 84.

The motivation for doing so would have been to perform critical operations in a concentrated manner as expressly taught by Yasuda et al. in paragraph 84.

Therefore it would have been obvious to combine Yasuda et al. with Nelson et al. for the benefit of efficient processing of critical operations to obtain the invention as specified in claim 1.

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3. **Claim 2** discloses, “the VM is still running when the COW disk file is created **[the VM running to create the COW]**”.

4. **Claim 3** discloses, “copying the parent disk file after any pending disk writes complete **[transferring the data saved in the temporary memory (RAM, Column 4, Lines 18-25) to “storage space” 14, Figure 1]**, and using the copy of the parent disk file for the checkpoint **[“snapshot” copy, Figure 3]**”.

5. **Claim 4** discloses, “committing the COW disk file into the original parent disk file **[committing the “snapshot” disk file based on the original parent disk file (Restoring the original based on the snapshot), Column 1, Lines 24-40]**”.

6. **Claim 5** discloses, “creating one or more new COW disk files **[RAID mirroring, Column 3, Line 7]** for use by the VM while the COW disk file previously used by the VM is being committed **[creating “snapshot”, Figure 3]**”.

7. **Claim 6** discloses, “the copy of the parent disk file is indicated for use for the checkpoint by adding a disk file pointer to the checkpoint file **[disk file pointers, Column 5, Lines 11-18]**”.

8. **Claim 7** discloses, “the steps of creating the COW disk file and handling disk COW faults are performed by a data storage device that is external to the virtual computer system [**“Host” 20, Figure 1**]”.

9. **Claim 8** discloses, “the step of saving the original VM memory to the checkpoint data store is delayed until all pending disk reads complete [**completing disk reads assigned prior to the checkpoint operation**]”.

10. **Claim 9** discloses, “raw data store in a data storage medium [**Figure 1**]”.

11. **Claims 10-13** disclose, “a file stored in a disk drive [**“RAID”, Column 3, Line 7**]/high-speed random access memory [**RAM, Column 4, Line 23**]”.

12. **Claim 15** discloses, “forcing memory COW faults on original VM memory [**reading the data saved in the cache (restored by the “snapshot” storage device), Column 4, Lines 20-23**] that is affected by any new disk reads, prior to issuing the new disk reads [**any subsequent reads**]”.

13. **Claim 16** discloses, “the resumption of the operation of the VM is delayed until all pending disk operations complete [**transferring the main memory contents to the disk, Column 4, Lines 18-25**]”.

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14. **Claim 17** discloses, “if the resumption of the operation of the VM is not delayed until all pending disk operations complete, reissuing any disk reads that affect any VM memory for which a COW fault has occurred **[transferring the data saved in the temporary memory (RAM, Column 4, Lines 18-25) to “storage space” 14, Figure 1] & [restoring the primary storage by using the snapshot storage]**”.

15. **Claim 18** discloses, “if there is a pending disk write to the same COW block group as a subsequent write for which a disk COW fault has occurred, delaying responding to the disk COW fault and delaying the subsequent write until the pending disk write completes **[transferring the data saved in the temporary memory (RAM, Column 4, Lines 18-25) to “storage space” 14, Figure 1] & [restoring the primary storage by using the snapshot storage]**”.

16. **Claim 14** is rejected under 35 U.S.C. 103(a) as being unpatentable over Nelson et al. (US 6,857,057) in view of Yasuda et al. (US 2004/0010654) as applied to claim 12 above, and further in view of Auclair et al. (US 5,778,418).

17. As per **claim 14**, Nelson et al. and Yasuda et al. disclose the method recited in claim 12.

Nelson et al. and Yasuda et al. do not disclose expressly, “flash memory”.

Auclair et al. disclose “flash memory” in column 1, at line 48.

Nelson et al., Yasuda et al. and Auclair et al. are analogous art because they are from the same filed of endeavor of memory access control.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to modify Nelson et al. and Auclair by including the “flash memory” as taught by Auclair et al. in column 1, at line 48.

The motivation for doing so would have been low power consumption, no presence of mechanical parts and fast access time as expressly taught by Auclair et al. in column 1, at lines 54-60.

Therefore, it would have been obvious to combine Auclair et al. with Nelson et al. and Yasuda et al. for the benefit of low power consumption and fast access time to obtain the invention as specified in claim 14.

Arguments Concerning Prior Art Rejections

1st Point of Argument

Regarding claims 1, 19, 20, 22 and 23, the applicant argues that Nelson fails to teach, “saving substantially all of the device state of the VM to a checkpoint data store”. However, Nelson teaches saving state of the primary VM to secondary VM via snapshot operation in Figure 3, wherein the secondary VM corresponds to the “checkpoint data store” from the claim.

2nd Point of Argument

Regarding claims 1, 19, 20, 22 and 23, the applicant further argues that Nelson fails to teach, "marking the set of VM memory as copy-on-write (COW)". The applicant supports his/her argument by stating the memory disclosed in Figure 1 of Nelson cannot be considered as a "VM memory". However, the claim defines a "VM" as a "virtual machine". Since Nelson teaches virtual disks ("virtual machine") and the cited "Memory" acts as a temporary storage area for the disks (Column 4, Lines 20-21), the cited "Memory" corresponds to the "VM memory" from the claim. Further, the examiner considers the snapshot operation between the virtual disks as the claimed "copy-on-write" operation, wherein the "memory" provides a temporary storage area for the virtual disks.

The applicant further argues that Nelson fails to teach, "allowing the VM to continue using the VM memory". However, Nelson teaches the system accessing the "memory" in Figure 3. The examiner suggests the applicant to be more specific regarding the limitation, "using" the VM memory.

3rd Point of Argument

Regarding independent claims 19 and 23, the applicant further argues that Nelson fails to teach, "responding to memory COW faults related to the VM memory by generating copies of the original VM memory for read and write use by the VM". However, Nelson clearly teaches generating snapshots of the original virtual disk in

column 1, at lines 37-39. If any faults occur to the original disk, the system responds by recovering the original disk by using the snapshot disk file.

4th Point of Argument

Regarding claims 3 and 23, the applicant argues that Nelson fails to teach, “allowing the VM to execute during at least a part of the time during which the checkpoint is being generated”. However, Nelson teaches transferring the data saved in the temporary memory to “storage space 14 in Figure 1. The examiner suggests the applicant to be more specific regarding what the VM is actually executing.

The applicant further argues that Nelson fails to teach, “ensuring that the results of any pending disk writes are applied to both the checkpointed virtual disk and the ongoing virtual disk” and “that the results of any pending disk reads are applied to both the checkpointed VM memory and the ongoing VM memory”. The applicant supports his/her argument by stating that the examiner’s citation has nothing to do with “pending disk writes/reads”, as that phrase is used in the instant application. The applicant supports his/her arguments regarding claim 3 by stating the same reason. However, Nelson clearly teaches “pending disk writes/reads” in the temporary memory in Figure 1, wherein the contents of the memory are transferred to/from disks.

The applicant further argues that Nelson fails to teach, “that the results of any new disk reads are applied to the ongoing VM memory, but not to the checkpointed VM memory”. The applicant supports his/her argument by stating that the examiner’s citation has nothing to do with either ongoing VM memory or checkpointed VM memory.

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However, Nelson teaches reading the new data that is the results of the "First Write" (49, Figure 3), which is only stored in the original virtual disk ("ongoing VM memory").

5th Point of Argument

Regarding claim 25, the applicant argues that Nelson fails to teach the recited claim limitations. However, Nelson teaches reading the data saved in the cache, wherein the data is restored by the snapshot storage device in column 4, at lines 20-23. The applicant states that the cited reference has nothing to do with reissued disk reads. However, the examiner kindly requests the applicant to explain how the claimed "reissuing" is patentably distinct from the cited issuing disk reads after data restoration.

6th Point of Argument

Regarding claims 15 and 26, the applicant argues that Nelson fails to teach the recited claim limitation. The applicant supports his/her argument by stating that the examiners citation has nothing to do with forcing COW faults for original VM memory. However, the examiner interprets the claim as fixing/recovering faults associated for the VM memory, which Nelson clearly teaches in column 4, lines 20-23. The examiner suggests the applicant to be more specific regarding the term "forcing".

7th Point of Argument

Regarding claims 18 and 28, the applicant argues that the examiner's citation from Nelson has nothing to do with the claim limitation. However, the cited data restoration results in the claimed data write delay.

8th Point of Argument

Regarding claims 1, 20 and 22, the applicant argues, "Yasuda et al. has nothing to do with stopping a VM". However, Yasuda et al. teaches stopping operation in a virtual network in paragraph 84.

The applicant further argues that the cited references fail to teach, "handling memory COW faults to the original VM memory to generate copies of the original VM memory for read and writ use by the VM". The applicant supports his/her argument by stating that the "storage space 14" does not correspond to the claimed "VM memory". However, the "storage space 14" is a virtual RAID snapshot system (Figure 3, Column 3).

9th Point of Argument

Regarding claim 8, Nelson discloses a snapshot operation (Column 4, Lines 20-23), wherein the contents of the original disk must be read prior to copying the contents to the snapshot disk.

10th Point of Argument

Regarding claims 16 and 17, applicant argues that the examiner's citation has nothing to do with the claimed limitation. However, the examiner suggests the applicant to specify what the "resumption of the operation" is since the examiner interprets the operation as any operations following/preceding the pending disk operations.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

A. Claims Rejected in the Application

Claims 1-28 have received a second action on the merits and are subject of a second action final.

B. Direction of Future Remarks

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jae Un Yu who is normally available from 9:00 A.M. to 5:30 P.M. Monday thru Friday and can be reached at the following telephone number: (571) 272-1133.

If attempts to reach the above noted examiner by telephone are unsuccessful, the Examiner's supervisor, Sanjiv Shah, can be reached at the following telephone number: (571) 272-4098.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

8/18/2007

Jae Un Yu
Art Unit 2185

J.Y.



SANJIV SHAH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100